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The Gendered Effects of Climate Variability/Change on Fisher Livelihoods and the Coping Strategies/Opportunities in Mbita, Homa Bay County, Kenya

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ABSTRACT

Global warming influences have brought negative climate change consequences on global livelihoods and household food security of the world's 36 million fisher folks and nearly 1.5 billion consumers who rely on fish for their dietary animal protein. Past studies have concentrated on climate change influences of marine and oceans' fisher communities; they have investigated mainly climate variability and climate change impacts on fish distribution and production. Limited studies have explored the interaction between impacts of climate change on the fishing activities on inland and fresh waters such as in Lake Victoria and the fishers' adaptive activities. The discussion of this article is based on a research which was focused on Mbita location on the shore of Lake Victoria where fishing is main livelihood activity of local community. The study was guided by the following research objectives to: Determine the influence of gendered effect of climate change/variability on fisher activities among the Mbita and Highlight the current coping strategies and underscore the possible opportunities available to the fishers due to CV/ CC in Mbita sub-county. The study used a constructivist epistemology paradigm and the mixed methods research design to collect and process the findings presented. Yamane's formula (1964) is used to get the sample size of 388 respondents out of a target of of 13191. Primary data was collected using questionnaires; interview schedules for KII and FGDs. Secondary data collection was collected through reviewing of relevant documented information, from fisheries and climate change reports, working documents and related research articles on Mbita for the last 30 years. The validity of the instrument was done through content validity with the supervisors. The instruments were piloted in test retest and data generated processed using computer supported software (SPSS) Statistical Package for Social Sciences and presented in descriptive and inferential statistics. The study found that there was reduced fish catch was statistically significant with a p-value of 0.000. The effect of climate change on the loss of life of the fishers is statistically significant with a p-value of 0.001 and under the objective on coping strategies the study found that adaptation required transformation of mind set that called for bigger investment which required the collaboration and consultation of entire Mbita community and county government to address environmental and conservative resource utility. The study concluded that lack of alternative livelihood opportunities/options is the major constraints to adaptation for people living in the Lake Victoria region escalated with limitation of skills outside fishing industry, limitation of other employable professional skills including lack of capital. The study recommends a trans disciplinary consientization of adaptive strategies which can translate into flexible and sustainable CCA gender inclusive livelihood activities. Future research should explore participatory action research on environmental influences affecting CCA by comparing findings across other beaches.

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KEYWORDS: *Gender; climate change and Livelihood adaptation*

1. INTRODUCTION

Gender refers to masculinity and feminity; staying clear of biological differentiation. Basically gender is socially constructed roles stereotyped on men and women girls and boys. It is a central organizing principle of societies, and often governs the processes of production, reproduction, consumption and distribution. Many communities in Africa use biological gender as a development planning tool for accessing and controlling livelihood resources.

On the other hand, the importance of fish cannot be ignored. It is the main source of dietary protein for over 1 billion people worldwide. FAO (2012) reported that global fisheries sector supported over 43.5 million people directly and over 200 million in associated fishery industries with the majority of these persons being in developing countries. Barange and Perry, (2010) found that fisheries employ around 10 million people is the only source of animal protein for over 20 per cent of the population in Sub Sahara Africa.

Globally fisheries are under intense pressure from habitat destruction, biodiversity loss, overfishing, pollution and ocean acidification and this situation is getting further complicated by the impacts of climate variability. IPCC (2014) observed that small scale fisher folk in the developing countries will be most vulnerable to climate change and variability due to high reliance on fisheries and poor adaptive capacity. It further stressed that climate change and variability will have a significant and long-term risk to fisheries in many tropical developing countries particularly in Sub Saharan African ultimately undermining the benefits gained from the development of fisheries sub sector.

A number of studies have investigated the vulnerability and adaptive capacity of the fisheries dependent community to climate change and variability but there has been little emphasis at the local scale on how impacts of climate change and climate variability is affecting the lives and livelihoods of the majority of small-scale fisher folks, who make up more than 90% of the world's fishers and fish trade (Badjeck *et al*.2009).

World Bank (2016) reported that the Lake Victoria Basin supports a population of 40 million providing a variety of economic and development opportunities from fisheries and tourism. This implies that all livelihood opportunities around Lake Victoria are under threat due to a number of environmental problems including pollution of the lake, biodiversity loss, habitat destruction, soil erosion and new impacts of climate change and variability. PREPARED (2014) added that the lake's shallowness, limited river inflow, demands on outflow, and large surface area relative to its volume make it highly vulnerable to climate variability.

1.1. Problem statement

Past studies of nexus of climate change and fishing livelihoods have had differing focuses, Odhiambo, (2013) focused on effects of weather and climate variability affected fishing activities and fishers' adaptive capacity in Mbita Sub County using survey method. His finding was that weather and climate variability had significant effect on fishing and livelihood activities, however he did not explore the gender construct. Sidi (2015) studied the adaptive capacity to climate change and food security among artisanal fisher folk in Rorya District, Tanzania using mixed methods. Her study found gender inequalities and disparity in access to and control to resources and education which accounted for disparities in adaptive capacities of the target study community but did not interrogate the implications of culture in these disparities. Daw *et al*. (2008) found that most inland fisheries are under intense pressure from overfishing, poor management practices, pollution and introduction of alien species. They further observed that the challenges were exacerbated by climate change impacts. The current study interrogated the influence of gender on climate change adaptation by the Fisher Community in Mbita, Homa Bay County, Kenya. Lake Victoria Basin is home to a population of 40 million persons yet over the last four decades the region has faced a number of environmental problems which could jeopardize the stability of their livelihoods.

1.2. Study Objectives

A. Establish the gendered effect of climate change/variability on fisher activities among the Mbita fishers.
B. Highlight the current coping strategies and opportunities from climate change/variability among the Mbita fishers.

2. Literature Review

2.1. Gender and climate change

Gender as a social construct is defined in terms of roles, responsibilities, and opportunities available to men and women; boys and girls. In development gender is used as a tool for organizing communities in traditional societies, and governing processes of production and reproduction, consumption and distribution of resources (FAO, 2015). Because of the different roles which men and women play culturally in communities, CC and CV affect them differently. Past studies on Sub Saharan Africa fishery activities (Béné and Merten, 2008; Nyukuri, 2016) found that fishery livelihood activities are highly gendered with men dominating knowledge of the extractive processes while the women's knowledge is limited to fishing post harvest activities, such as processing and trading. This implies that women are likely to be more prone than men to CC and CV.

2.2. Gendered Roles in Fisheries

In Sub Saharan Africa, men and women participate in different but complimentary activities in the fisheries. The men's activities dominate mainly the extractive processes while the women are often responsible for post-harvest activities, which frequently earn a narrower profit margin than that made by fish catchers (Béné and Merten, 2008). The fisheries are governed by a highly gendered labor and power distributions practices that involve restrictions on access to fishing grounds, unequal control over fisheries governance, or unequal access to resources needed to engage in fishing. Therefore, barriers can result in fewer benefits from fisheries accruing to women, thus largely keep control of the fishery in the hands of men, even though women's roles in fish trading and processing are affected by fishery conditions (Nyukuri, 2016).

2.3. Effect of Climate Variability and Change on Livelihoods of Fishers

Climate variability and change affects various livelihood assets, activities and outcomes (Balgis *et al*., 2005) of fisher communities. The recession of Lake Victoria water levels caused a decrease in fish catches affecting livelihoods of fisher communities around the lake (Rubaru *et al*., 2012); impact of climate variability and change on availability of fish products, revenues, harvesting strategies, processing and marketing will disrupt fishing operations and affect the fisher communities. Severe weather conditions damage assets and infrastructure such as landing sites, boats and gear and disruption of marketing systems and loss of lives (Rubaru *et al*., 2012).

Climate variability and change through rise in water levels, storm and flood frequency can impact on the human and social capital of a community. Badjeck *et al*., (2009) points out that different dimension of human capital, ranging from safety-at-sea to food security are also affected by climate variability. The loss of lives, for example, can be the most dramatic impact of extreme climatic events on human capital, affecting not only surviving household members but also potentially disrupting economic and social activities. Additionally, loss of revenues can be the result of closure or reduction of fisheries activities during weather anomalies (Nagy *et al.,* 2006).

2.4. Fisher communities coping and adaptation strategies

Climate change and variability is viewed to have its greatest impact on poor households because they have the lowest capacity to adapt to changes in climatic conditions (Salau *et al*., 2012). The ability of individuals and communities to adapt to climate change depends on their vulnerability, exposure and adaptive capacity (Amwata *et al.,* 2015). Past studies illustrate that fishers adapt to the impacts of climate variability and change in various ways. When faced with declining yields, income and food security, fishers may seek alternative resources. West African studies show that when coastal fisheries resources are scarce, fishers adopt alternative livelihood strategies including hunting for bush meat (Brashares *et al*, 2004). From Lake Malawi area the fishers cope by diversifying into farming and pastoralism while others migrated in response to the decrease in fish catches that followed the drop in lake levels (Njaya *et al*., 2011).

2.5. Barriers/Constraints to Adaptation

Barriers to adaptation are obstacles that affect adaptation and also impact the adaptive capacity of a system. This is because adaptive capacity determines how effective system can respond to stressors (Clarvis and Engle,2015).The most commonly reported barriers are linked to the institutional and social dimensions of adaptation and are context specific across space, time and sector (Biesbroek *et al*., 2013). Nyboer, (2016) assessed the adaptive capacity of fishing communities to climate change in the Lake Victoria basin of East Africa and found that the main barriers to climate change adaptation among the fishers was poverty as the impoverished households often have no choice but to alleviate immediate pressures of hunger, illness, and child care by relying solely on fishing.

3. Conceptual framework

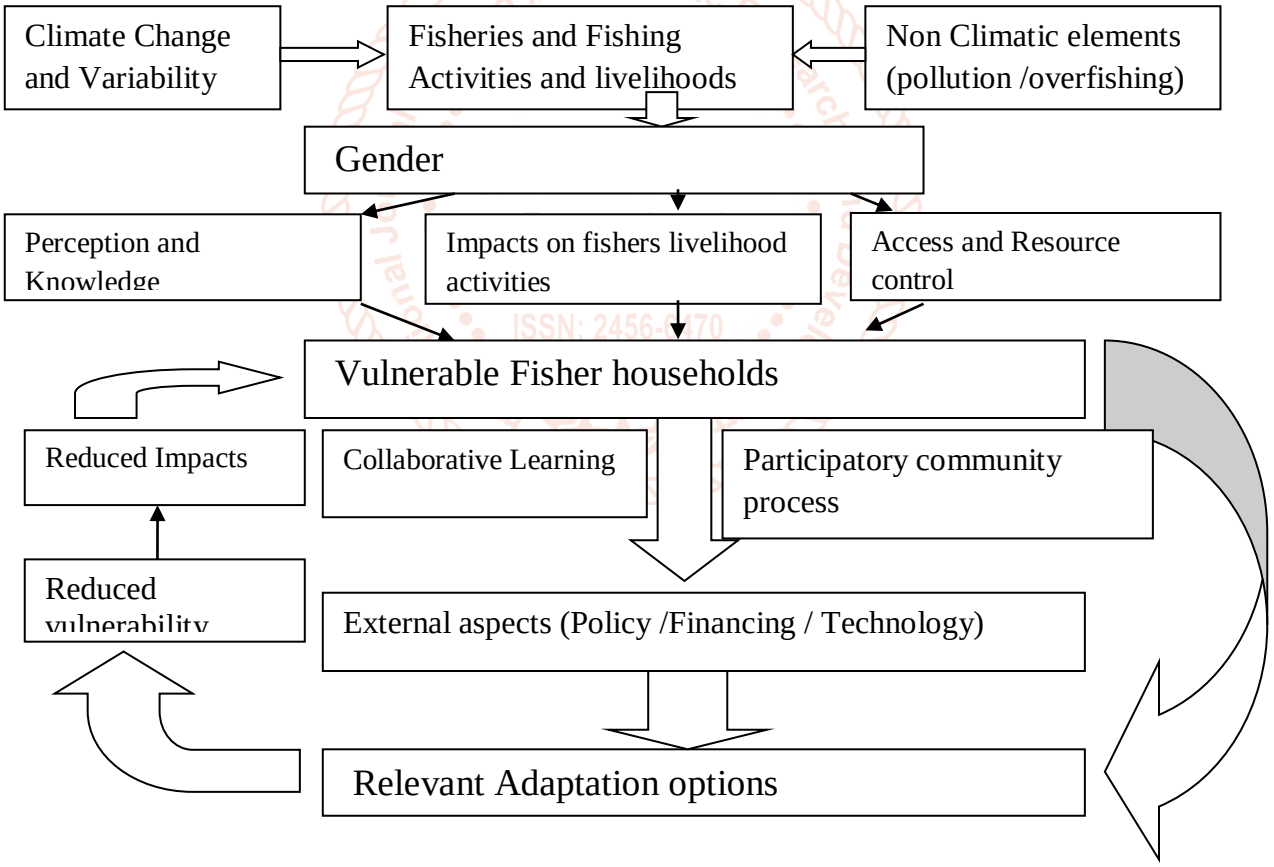

Fig 3.1 Conceptual framework by researcher 2019.

The operationalization of the conceptual framework brings a holistic approach to comprehending the influence of gender on climate adaptation by the fishers in Mbita. The framework identifies that climatic and non-climatic elements influence fish, fishing activities and fishing livelihoods from the volumes of catches, varieties caught, the catching, processing and marketing of the fish. The outcome of this complex situation interacts with the dynamics of gender which used here as a differential planning tool that is strictly observed by the local cultural norms and values within the fisher community. These norms mediated with gender interface interact differently with perception and knowledge; livelihood activities and resource access and control accounting for the different levels of vulnerability. Navigating to sustainable livelihoods requires the participatory community processes reinforced with collaborative learning.

3.1. Area of study

The study focuses on Mbita in Home Bay County, a small, rural town located along the shores of Lake Victoria, near the southwestern border of Kenya, located on a peninsula, with water on three (3) sides and surrounded by picturesque islands between latitudes 0° 21' and 0° 32' south and longitudes 34° 04' and 34° 24' east (HCIDP, 2017). PREPARED (2014) projected temperature increase in the Lake Victoria Region (3 to 4°C) by the end of this century a state that would further affect the region's rainfall regime. This coupled with dwindling fish stocks due to overfishing will increase the pressures on the fishers' livelihoods.

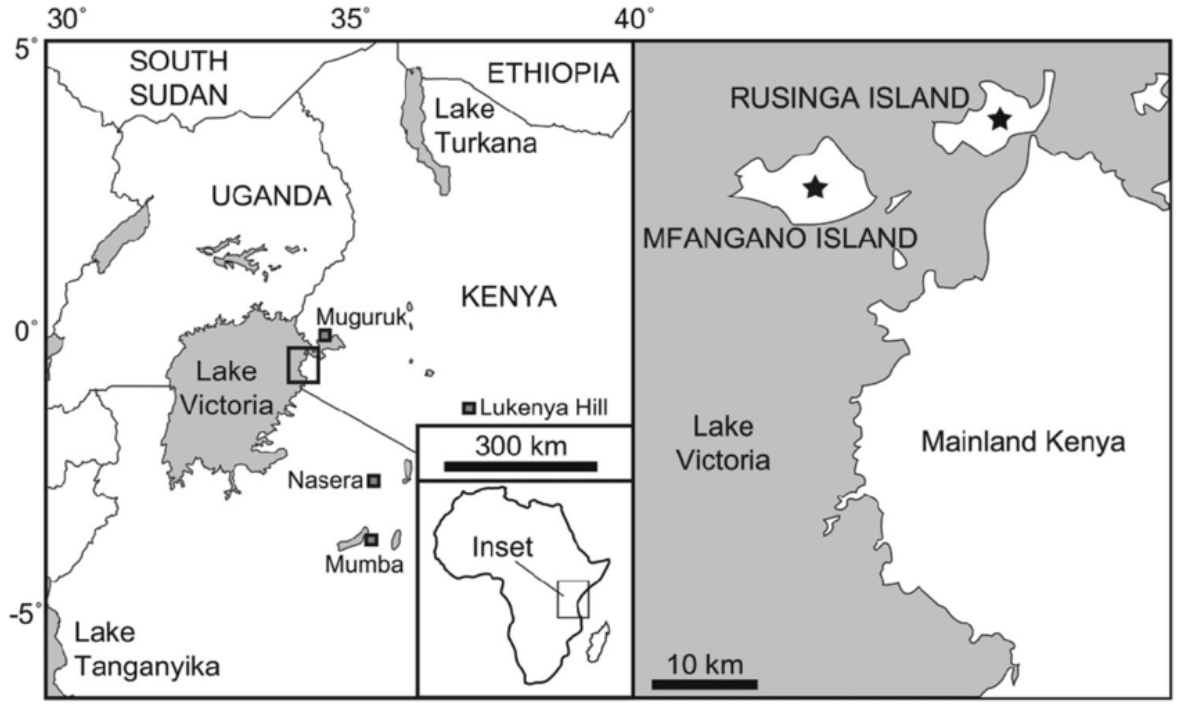

Figure 1.1: Map of study area
Source: GoK (2013)

3.2. Study design

The study used mixed methods research design. Tashakkori, and Teddlie (2010) explain that mixed method enables researcher to complement qualitative approaches with quantitative ones in order to allow for more complete interrogation of the study variables

3.3. Target Population

The study targeted 13191 who are scattered across the Rusinga and Mbita (Lake Victoria Fishers frame survey, 2016).

3.4. Sample size and Sampling Procedure

The sample size was calculated using Yamane's formula: Yamane (1967) states, for a 95% confidence level and $p = 0.05$, size of the sample should be $n = \frac{N}{1} + N(e2)$ where, N is the population size and e is the level of precision. In using this formula to get a sample number from our population, in which N =13,191 with ±5% precision. Assuming 95% confidence level and p =0.05, we get the sample size of 388.

3.5. Data Collection Procedures

The researcher obtained all required permits from the graduate school of UoN. Quantitative data was collected using semi structured questionnaires while qualitative data was collected using FGDs and KII interviews. Secondary data consisting of published peer reviewed scientific articles focusing on climate variability and change perceptions, impacts of climate variability and change on fisheries, adaptation in the fisheries sector will be consulted. Meteorological data from the Meteorological station in ICIPE was used to get the temperature and rainfall trends and data on fish production was accessed from the Fisheries Department and the BMU offices in Mbita to give further insights into the study.

3.6. Data Analysis and Presentation

Data was analyzed using computer supported software SPSS and presented in descriptive statistics while qualitative data was analyzed thematically and presented in prose.

4. FINDINGS AND DISCUSSIONS

4.1. Socio-demographic characteristics of the respondents

The study found that 65% of the respondents were male while 35% were female. On age distribution, only 3% were <19years of age ; 32% were between 19-28 years of age ; 40% were between 29-38years of age; 16% were 39-48 of age; 5% were 49-58 and 1.9% of them 59+years.

On marital status, it was found that 25% of the sample were single; 55 of whom were males and 22 females; 39% of the married of whom 80 males and 37 females; 9% of the sample were divorced 15 of whom were 11 females and 4 were males; 19% of the sample were separated 34 males of whom 23 were females and 11 males and 9% of the sample were widowed/widowers whereby 15 were males and 13 females.

On education level of the sampled fishers the study found that 4% had no education at all: of these 7 male and 4 females; 51% had primary education of whom 93 males and 62 were females; 39% attained secondary education of who 84 were males and 36 females; and finally 7% acquired some tertiary education of whom 17 males and 3 females.

On household's headship the study found that 64% were male headed ; 32% female headed and only 4% child headed in proportion of 2 female and 2 male households. Out of the female headed household 30% had open-access fisheries which enabled mainly widows to make a living from it.

Concerning household size, the study found that 57% of the sampled households of whom 112 males and 63 females were living with between 0 - 3 people in their houses; 40% of whom 82 males and 41 females were living with 4 - 7 people in the household but 3% reported that they were living with 8+ people in the same household

4.1.1. Livelihoods and Livelihood activities

The study found that 67% of the sampled fishers solely depended on fishing as their main source of livelihood 134 male and 70 female. The study established that next dominant source of income was mixed cropping and fishing accounting for 23% of the respondents made of 48 males and 23 females; 6% of the respondents engaged in livestock rearing distributed in 13 males and 4 females and 4.5% of the sampled fishers engaged in other activities of whom 6 were males and 8 females.

On roles taken in the fishing activities 9% the respondents owned or made boats disaggregated into 19 males and 8 females; 45% of the respondents were either fishermen/boat crews and were all males. It was found 68% of respondents had direct fishing roles were males; while 34% composed of 79 females and 26 males engaged in fish marketing.

On the duration of time the respondents, 21% of the sample reported that they had been involved in fisheries for <5 years; of these 43 were males and 21 females; 44% of the sample had been in fisheries for a period of 6-9 years in distribution of 85 males and 49 female ; 20% of the sample had been in fisheries for between 10-14 years in distribution of 38 males and 24 females; 10% of the sample had been in fishing for between 15-19 years distributed into 21 males and 8 females and 6% of the fishers stated that they had been in fishing for a period exceeding 20 years.

On estimates of monthly incomes; 53% of the respondents comprising of 99 males and 62 females made (0- 4999) Ksh a month; 26% of the respondents comprising of 56 males and 24 females made (5,000 – 9 ,999) Ksh a month; 11% of the sampled fishers made 10, 000 - 14999 Ksh a month in the distribution of; 5% comprising of 24 males and 9 females made (15,000 to 19,999) and 5% of the respondents made of 9 males and 7 females made Ksh20, 000/- plus in month

4.2. Findings on objective 1. The gendered effects of climate change/variability on fishing and on fisher livelihoods

4.2.1. Increased fish types

70% of the respondents comprising of 137 male and 77 female fishers reported there was no increase in fish types however 30% of the respondents comprising of 64 male and 28 female fishers reported an increase in fish types especially the wet seasons. The latter group reporting was consistent with LVFO Frame Survey (2016) that reported increase of small pelagics specifically *Omena* and Haplochromines locally known as *Fulu* .

4.2.2. Reduced fish sizes

The majority 85% of the respondents affirmed a reduction in fish sizes over time; these comprised of 177 male and 83 females. On the contrary 15% of them comprised of 24 male and 22 females did not think there was any reduction in fish sizes. The observations of the 1st group is consistent with Kolding *et al* (2019) that reported that CC caused reduction in fish sizes in all the major African Lakes and reservoirs.

4.2.3. Reduced Fish Catch Volumes

A majority 87% of the respondents composed of 173 males and 91 females reported a reduction in fish catch resulting from CC. The reasons given were that more people were entering the fishing area resulting into final reduction each fisher could net in. The finding is consistent with Onyango (2005) who found that because of accelerated fishing effort has been rising the catches were consistently showing a decline due to high fishing pressure leading to over-fishing and depletion of stocks.

4.2.4. Increased Fish Catches

Oddly 14% of the respondents consisting of 24 males and 20 females confirmed that fish catches had increased particularly the *Omena* and *fulu* seasonally contrary to what 86% of the respondents made of 177 males and 85 females, who claimed little or no increases, probably they were too engrossed in the daily fishing activity to bother associating the volume of catches with CC provided they were able to get what they needed. The graph below constructed from raw data from raw data from Mbita Fisheries Office below was handy in authenticating what fishers reported with what actually occurred on the ground

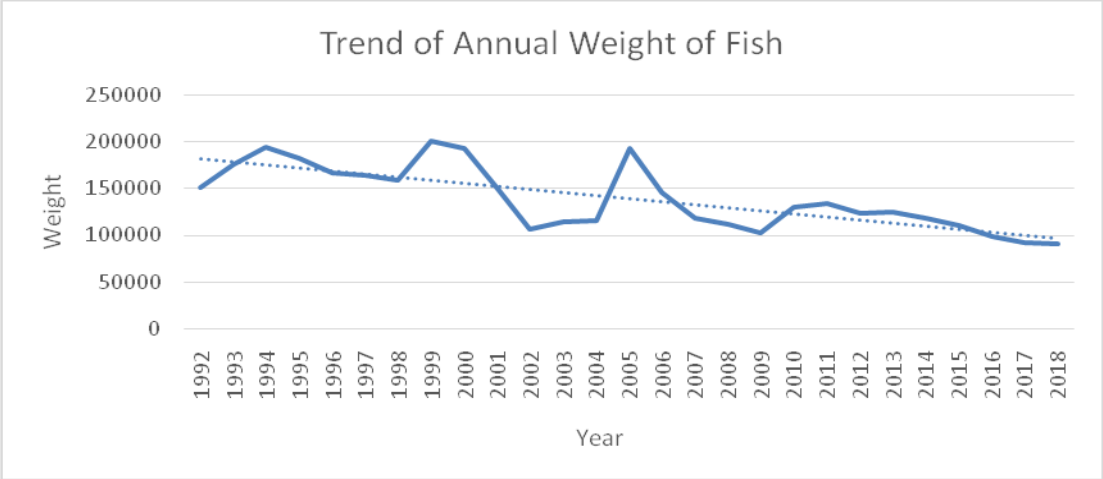

Figure 7.1 Fish Catch Graph of Trends 1992-2018
Source: Raw data from Mbita Fisheries Office

According to the LVFO 2016 catch survey, the total annual fish catches reduced from the average monthly total catches indicated that Nile perch and Tilapia total catch estimates decreased by 34.2%, from 251,063 tons to 165,084tons and by about 65.9% from 59,681 to 20,371 tons in 2014 to 165,083 tons in 2015 respectively. While the Omena catch estimates increased by 11.2% from 509,598 tons to 566,570 in 2015. Haplochromines catch estimates increased by 20.7% from 73,556 tons to 88,794tons in 2014 and 2015 respectively. The total lake-wide catch declined by 4.7% from 919,310 tons to 876,547 tons between the two surveys.

4.2.5. Staying Away From Home Longer for Fishing/Marketing

The majority, 70% of the respondents comprising of 169 males and 46 females reported that they stayed away longer to get the catch they realized compared to earlier times and they associated this with overfishing and seasonal climate changes. On the other hand, 30% of the respondents 36 males and 55 females did not stay away longer; these are among the people who supplemented their fishing activities other livelihood activities like subsistence farming and other smaller trades.

4.2.6. Reduction in Access to Food due to lose of revenue.

The majority 87% of the respondents made up of 171 males and 94 females expressed that their access to food had reduced resulting from changing amount of fish catch volumes and revenue. These represented the category who are wholly dependent on fishing livelihood and whose food security stability rested squarely on fish related incomes. The female fishers reported that in their households they were eating fewer meals and reducing the amount of food eaten as a close gap measure during the time their revenues from fish reduced in order to guarantee their survival.

4.2.7. Lack of Road Access and Storage

23% of the respondents comprising 35 male and 24 females respondents cited lack of road access and lack of storage facilities as major challenges. Fish and fish products are highly perishable commodities requiring the shortest time between the landing and marketing. Fish and is prone to autolysis within a short time and lack stated that road access and bad roads during heavy rains delayed fish transportation to market causing fish to decompose before reaching the markets; 76% of the respondents comprising of 167 males and 70 females who mainly sold their small catches locally didn't think much about road challenges and the fish spoilages however they agreed that when the roads were unreachable they sold their fish cheaply to traders who had refrigerated containers.

4.2.8. Weather Related Loss of Lives/Property

The majority 71% of the respondents comprising of 143 males and 73 females had lost relatives and friends from fishing accidents during stormy weather which often caused boats to capsize and drown often times the entire crew and catches they were carrying; 29% of them ,comprising of were 58 males and 32 females declined the discussion on calamities in the fishing expeditions because they had accepted it as part of the game in fishing livelihoods.

4.2.9. Health Relative to Dry and Wet Seasons

The majority 82% of the respondents comprising of 168 males and 82 female, reported frequent sicknesses like malaria corresponding with mosquito increase in wet climatic scenarios and typhoid associated with unsafe drinking water at the beaches while 18% of the respondents made up 33 males and 23 females remained pensive however in focus group discussions the engaged respondents decried the hazard fishers face was vast ranging malaria, cholera, diarrhoea and typhoid associated with the lack of access clean drinking water and unorthodox latrine practices.

4.2.10. Reduction on Number of Fishers/Traders

Only 11% of the respondents made up of 24 males and 9 females reported a decrease in fishers/traders due to ill health, fisher migration or change in livelihood activities while 89% of the respondents comprising of 177 males and 95 females said that the numbers remained constant because when some people migrated others moved in to replace them. According to the fishers, the increase in fishing pressure due is catalyzed with high levels of unemployment of youths. The observation reinforces

(KNBS, 2018) which places unemployment rate in Kenya at 9.6 % and the low education levels of the fishers among fisher communities.

4.2.11. Effect on Overall Livelihoods

The majority 92% of respondents made of 187 males and 94 females responded that CC had affected their livelihoods negatively as it interfered with health and means of earning; 8% of respondents comprising of 14 males and 11 females expressed that their livelihoods were not disturbed by CC scenarios.

Table-4.1 -Statistical correlation of effects of climate change on the fishing activities and livelihoods in Mbita Sub-county.

Fishing activities and livelihood	Male (Yes %)	Female (Yes %)	p-value
Increased fish types	31.9	26.7	0.099
Reduced fish sizes	88.1	79.1	0.001***
Reduced fish catch	86.1	79.1	0.000***
Increased fish catch	12	19.1	0.148
Stay away for home longer	82.9	47.7	0.004***
Reduced access to food	85.6	89.5	0.06
Spoilt fish	17	33.4	0.444
Less income from fish sales	92	91.4	0.239
Loss of life	28.6	30.5	0.001***
Frequent ill health	83.5	78	0.165
Loss and destruction	84	40	0.000***
Reduced number of trader	88	90.4	0.076
No effect	6.9	10.5	0.276

***** Significant at 5% level**

Table 7.1 above provides the statistical correlation of effects of climate change on the fishing activities and livelihoods is explained. From the table it can be noted that the change had a statistically significant effect on reduced fish sizes with a p-value of 0.001. Reduction in fish catches which directly affected their overall earning thus reduced fish catch was also statistically significant with a p-value of 0.000. Staying out longer for fishing/marketing was also statistically significant with a p-value of 0.004. On whether the climate variability /change led to loss of life of the fishers, 28.6% of the male respondents and 30.5% of the female respondents concurred with making it statistically significant with a p-value of 0.001. Loss and destruction of life/property among the fishers was statistically significant with a p-value of 0.000. However as much as the climate change had some effects on; increased fish types, increased fish catch, reduced access to food, spoilt fish, less income from fish sales, frequent ill health, reduced number of traders, and if it had no effects on the fishers; the effects were considered statistically insignificant (with *p-value >0.05*) although they still formed confluences of negative effects of climate variability on fishers in Mbita.

4.3. Findings on objective 2 which sought to establish the adaptation strategies of the fisher community in Mbita. The study found completely gendered adaptive activities which were consistent with roles men and women played in fishing as part of their livelihoods.

4.3.1. Shifting Fishing Time

The majority 56% of the respondents out of whom 168 were males and 4 were females had shifted their fishing times. During the rainy weather they went fishing early in order to reduce risks associated with afternoon storms; this finding was consistent with Nagy *et al.* (2006) who found that fishermen adapted by using cautious behavior to avoid weather related risks.

4.3.2. Fishing for Longer Time Periods of Time

Just 46% of the respondents comprising of 139 males and 3 females stated that they fished for longer time going into deeper waters during dry seasons compared to earlier times when fishers were fewer. On using modified fishing nets 40% of the respondents said that they changed fishing nets and boats to catch any size and type of fish; changing of boats was necessitated to cope particularly with strong winds. Boat owners invested on bigger engines and more fuel to go further into the lake and enabled them better catches.

4.3.3. Marketing Adaptation

The majority 28% of the respondents comprising of 46 males and 40 females reported selling fish to only big buyers in effort to sustain their market while 33% of the respondents composed of 34 males and 67 females processed fish before selling it to small buyers for a higher prices.

4.3.4. On use of savings and selling of assets to sustain their livelihoods

The majority 55% of the respondents reported they used their saving to sustain their household when fish catches dropped. While 34% of the respondents made of 78 males and 26 females resorted to selling their assets to sustain their livelihoods during the times of acute fish shortage. From FGDs across the beaches sampled, the female fishers reported that they obtained permission from men to sell / it the men who actually sold the property as *bonafide* owners of what families owned culturally.

4.3.5. Migratory fishing

Only 41% of the respondents comprising of 103 males and 21 females said that they had migration to places/beaches with more fish intermittently. From FGDs across beaches, the study found that males temporarily migrated to other beaches or even to other lakes to cope with climate variability which reduced fish catches; they also migrated to calmer and better fishing waters like Lake Turkana and Uganda waters. The few females who migrate between fishing sites did it to buy fish for resale and particularly when there was not enough fish at the beaches where they were and had to meet tender orders from their regular customers.

4.3.6. Other Adaptive Strategies.

From FGDs the study found that most of the fishers had adopted multiple occupations/alternative livelihoods to deal with reduced fish catches and subsequent lower incomes. These included farming/livestock and poultry rearing, small businesses like running bars/hotels/selling second hand clothes, betting/selling harvesting sand, firewood] .Plates 8.1 - 8.4 below show some activities the fishers engaged in inn response to the changes they have experienced.

Plate 8.1 Boda Boda riding

Plate 8.2 - Sale of livestock

Plate 8.3 Firewood for fish processing

Plate 8.4 Sand harvesting

Table 4.2 Determination of statistical significance of the fishers communities coping/ adaptation strategies to CC in Mbita.

Climate change adaptation	Male(Yes%)	Female(Yes%)	p-value
Shifted fishing time	83.5	3.8	0.000***
Fish for longer time period	69.2	2.8	0.000***
Fish further away than before	67.7	3.8	0.000***
Changed fishing nets/boats	56.7	7.6	0.000***
Catch any fish species	45.8	2.9	0.000***
Sell to big buyers	22.9	38	0.676
Process and sell to small buyers	17	63.8	0.000***
Received help from family members	20.12	48.98	0.000***
Used savings to sustain household	44.2	74.3	0.074
Sold assets to sustain livelihood	45.3	35.2	0.000***
Migrated places to places	51.2	20	0.001***

***** Significant at 5% level**

As represented in the table the adaptive and coping strategies used by fishers were gendered and roles stereotyped on cultural approval of the local community. Shifting of fishing time was practiced by 83.5% of male respondents and only 3.8% female respondents with a statistical significance of p-value of 0.000. Again fishing for a longer time as a coping/adaptation to CC strategy was adapted by 69.2% male respondents while only 2.8% female counterparts were into longer time fishing adaptation with a statistical significance of p-value of 0.000. On fishing further away than before was practiced by 67.7% of the male respondents while only 3.8% of their female counterparts who were boat owners practiced it giving a statistical significance of p-value of 0.000. Changing their fishing nets/boats was statistically significant with a p-value of 0.000. When asked if they had resorted into catching any fish species as a coping and adaptation strategy;45.8% of the male fishers respondents agreed with this while only 2.9% of their female counterparts agreed with this, this was statistically significant with a p-value of 0.000.

Processing and selling to small buyers as a coping and adaptation strategy was practiced by 63.8% of the female respondents while only 17% males practiced this with a statistical significance of p-value of 0.000. Receiving support from family members as a coping/adaptation strategy was reported by 20.12% of the male respondents 48.98% of their female counterparts explained that they survived from family members support with a statistical significance of p-value of 0.000; asset sale as CC adaptation strategy practiced by 45.3% male respondents while 35.2% of female headed households said in extreme situations they sold assets with a statistical significance of a p-value of 0.000 and migratory fishing was used by 51.2% of the male respondents and 20% female respondents with a statistical significance of p-value of 0.001. Selling of big fish to big buyers and using of savings to sustain households by the fishers as ways of coping and adaptation strategies were not statistically significant at p-values > 0.05.

4.4. Climate Change Opportunities

Despite the constraints cited the fishers were able to identify possible opportunities to CCA.

4.4.1. Development and implementation of community based climate change resilience strategies

The majority, 69% of the respondents saw the changes as a plausible opportunity for the strengthening of institutional capacities and the enhancement of good governance for effective and efficient processes would mainstream the authority of BMUs to promote unified CCA. Fishers also saw opportunity in empowering governance mechanisms into robust fisher communities capable of facilitating collective action resilience strategies.

4.4.2. The integration of knowledge

68% of the respondents made up of 121 male and 86 female saw the opportunity for knowledge integration for all the relevant actors at different levels and sectors of government, civil society, and academia and community organizations to engage in an interactive process through which pathways and policies can be defined and implemented. There exists an opportunity for relevant authorities to partner with the local communities particularly in improving climatic data observation and develop and promote products and services by involving the community in data collection and sharing of their IK to produce and dissemination climate information the form of bulletins and periodic forecasts, extreme weather alerts, and relevant information this would enhance uptake as the community would see themselves as stakeholders and co-producers of knowledge

4.4.3. Divesting and Expansion into the Utility of Related Fish Products

48% of the respondents saw both divesting and expansion of fish related production as an opportunity made up of 78 were male and 67 were female. A potential opportunity that the fishers stated was is that process and use of Nile perch oil as an alternative to the vegetable oil and given that they are already using it to deep fry fish and fish by-products because it is cheaper than other commercial fats and oils, such as vegetable oil there is the opportunity to process and sell this commercially further already being exploited by some fishers for dietary use as the oil is believed to have therapeutic value to human beings.

4.4.4. Revitalization of fisher networks

This was seen as an opportunity by 81% of the respondents of these 178 were male and 73 female. Around the world social organizations and fishers cooperatives have posted good results especially in improving fisher's status. Practical examples include fishing cooperatives in Japan, Netherlands and United Kingdom (Phillipson 2009) which besides addressing fisher's benefits, organizations embedded on the collective action theory enhanced management of the resource. With such a union the fishers can build up their position and start fish filleting so as to be able to compete effectively with the current filleting plants and gain entry into the lucrative export market. They however will need education about the running and operation of cooperative unions, which ideally would be provided to them for by an extension service.

4.4.5. Other opportunities

From the FGDs the fishers suggested that the changes in climate/weather offer an opportunity for the government both national/county to reorganize the fisheries and the fisher livelihoods to ensure its sustainability. The fishers felt that there is an opportunity for enhanced financial and structural support to help in reducing particularly with diversification to non-fishery activities being an option that could be the most beneficial as it successfully contributes to improved income, food security and employment for fisher communities. Given the growing demand and prices for fish and fisheries products an opportunity presents for promotion of aquaculture production in the lake area with the county government and national government providing enabling infrastructure and services for the small scale fishers,

5. Conclusions and Recommendations

5.1. Conclusions

The study concluded that the overall CC and CV impacts negatively on the overall health and livelihoods of majority 92 % of respondents; CV/CV directly affected the species and volume of fish caught in wet and dry weather respectively and caused direct food insecurity to the fisher community whose main income depended on fishing activities. The study found that wet season brought abundant fish in volume and species while in dry season fish reduced in volume, sizes and species for 85% of the respondents; also wet season attracted increased number of fishermen dry season translated into over fishing and fishing for longer for even smaller volume of fish which resulted into food insecurity due to less money from sales forcing households to survive by reducing food portions to survive.

The fishers had limited applicable adaptive alternatives as shifting fishing sites and using twin engine boats would have been climate smart options of adaptive fishing but had cost implications the majority of fishers could not afford the county government must mainstream fisher livelihood as part of sustainable development agenda. The study found that adaptation/coping strategies and activities in Mbita were culturally and gendered stereotyped in fishing activities and responsibilities giving men more adaptive options than women. It was found that fishers' households adapted during extremes through us of savings, sale of family assets to sustain HH, dependence on well-wishers and relatives or engagement in multiple occupations/alternative livelihoods including *bodaboda* riding for men, running small businesses eg bars/hotels/selling second hand clothes mainly women) and betting/selling harvesting sand, firewood for men and women.

5.2. Recommendations

The study recommends that Homa bay County Government should support effective response structure to CC and CV to enhance community resilience through exploiting gender inclusive opportunities to diversify livelihood activities. On the whole the fishers for institutionalized CC adaptation pathways which will formulate and mainstream at all beaches sustainable fishing there is need to reduce fishing frequency, and numbers of fishermen and boats sustainable livelihood activities in the entire County of Mbita

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